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Introduction & Methods

•Sea ice predictability has become a growing area of research over the last decade, spurred by a combination of environmental (sea ice loss, rapid warming) and socio-economic (enhanced economic interests, national security) factors.

- What is the skill of weekly forecasts of sea ice extent?
- How does the skill of extreme losses in sea ice extent compare to the overall skill?
- What can we learn from extreme case studies?

•We use the S2S dataset to quantify skill of sea ice forecasts over 1999-2014
•We use four S2S models: UKMO GloSea5, ECMWF IFS CY43R1, METEOFR CNRM-CM6.1, NCEP CFSv2

•To investigate the forecast skill of the January 2022 Arctic cyclone, we use the ECMWF IFS operational C47r3 model

Record Arctic cyclone of January 2022

•On 24 January 2022, a record low SLP Arctic cyclone with a central pressure of 932mb was observed. This cyclone resulted in a record weekly loss of sea ice cover in the region.

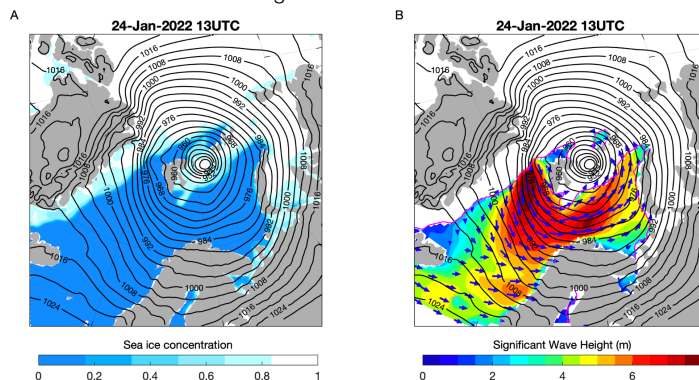


Fig 4. SLP on 13UTC January 24th 2022, sea ice concentration (SIC, panel A), and ocean significant wave height (panel B).

Results

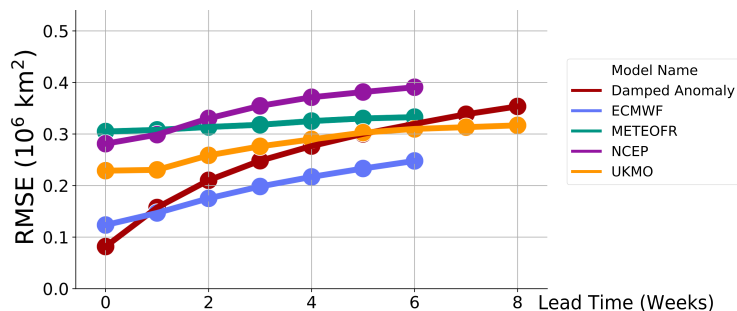


Fig 1. Root-mean-square error (RMSE) of anomalous Arctic sea ice extent forecasts (seasonal cycle is removed) for each S2S model as well as the damped anomaly benchmark forecast.

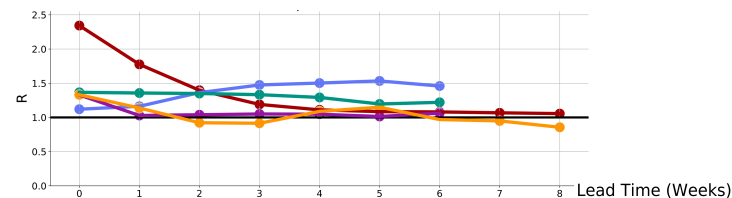


Fig 2. Ratio (R) of forecast RMSE on days with extreme sea ice loss to all other days. In general, forecast skill is lower for extreme sea ice loss events ($R>1$).

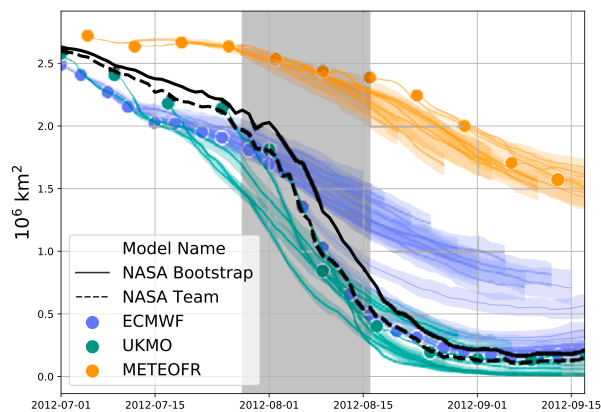


Fig 3. Sea ice extent (SIE) forecasts for the Chukchi-Beaufort-East Siberian region in summer 2012, which led to the observed record low SIE.

Summary

•In general, weekly forecasts of sea ice extent in the S2S archive do not beat a damped anomaly benchmark forecast, with the exception of the ECMWF S2S forecasts

•Forecasts of extreme sea ice loss events show less skill compared to all forecasts, but with model spread in skill and initialization.

•Case studies can be useful to diagnose the source of forecast error, which at weather timescales appears more related to sea ice initial conditions/sea ice physics than atmospheric forecast skill

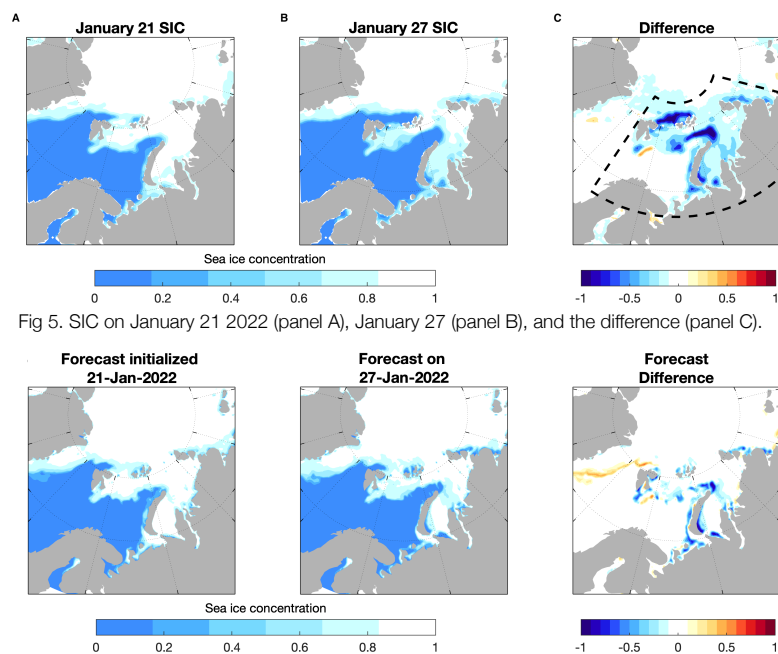


Fig 5. SIC on January 21 2022 (panel A), January 27 (panel B), and the difference (panel C).

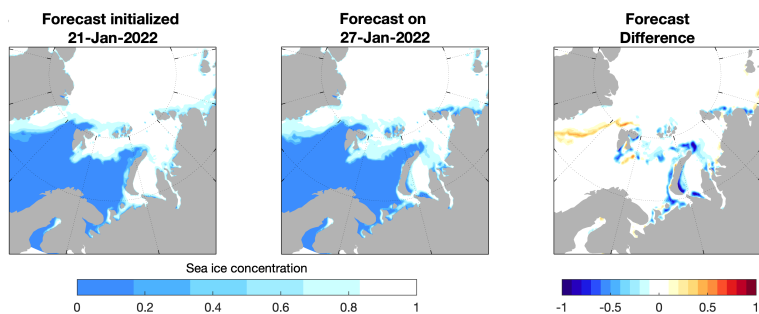


Fig 6. Forecasts of SIC initialized on January 21 2022 (left panel) for January 27 (middle panel), and the difference (right panel).

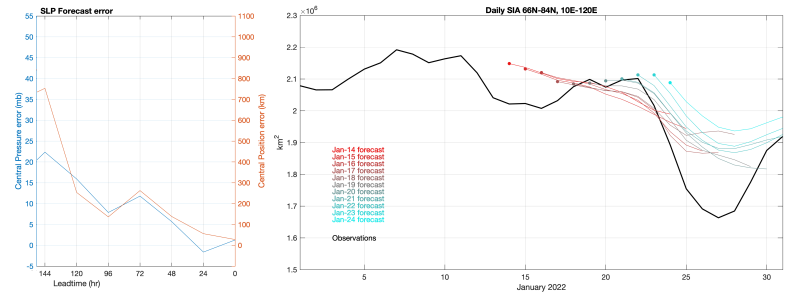


Fig 7. Cyclone forecast skill (left panel) and observed sea ice area (SIA, in black) for the Barents-Kara-west Laptev seas (dashed box in Fig3C above), and the forecast SIA (colored).

References

McGraw, M.C., Blanchard-Wrigglesworth, E., Clancy, R.P. and Bitz, C.M., 2022. Understanding the Forecast Skill of Rapid Arctic Sea Ice Loss on Subseasonal Time Scales. *Journal of Climate*, 35(4), pp.1179-1196.

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